The vacuum impregnation (VI) process allows modifying the structure of the plant tissue without affecting its integrity. The process includes two stages: the first is based on pressure reduction (vacuum time) and the second is associated with the restoration and the maintaining of the atmospheric pressure (relaxation time). Pressure changes induce the mass transfer which is explained by deformations of the material (Deformation-Relaxation Phenomena - DRP) and hydrodynamic mechanism (HDM). The VI process may reduce the pH and water activity of the product, change its thermal properties, improve texture, color, taste, and aroma. Additionally, bioactive compounds may be introduced together with the impregnating solutions and thus improving health-promoting properties of plant material. Unfortunately, the wider use of this technique is limited due to high rigidity and low effective porosity of the plant tissue. To solve this issue, the intensification of mass exchange processes is necessary. It may be achieved by the application of ultrasound. Although, ultrasound has been successfully applied in a wide variety of unit operations such as extraction, drying, emulsification, homogenization, mixing etc., its use during vacuum impregnation is an innovative approach. The main aim of the presented project is

a comprehensive analysis of the impact of ultrasonic waves on the vacuum impregnation of plant materials.

The scope of the analysis includes both the efficiency of the impregnation process (*intensification of mass exchange*) and the properties of materials being impregnated (*structure, composition, functional properties*). Because the impregnated products require preservation, the outlined research includes also the analysis of the influence of acoustic waves (used during impregnation) on the kinetics of convective drying, as a one of the most often used preservation technique. Such an approach will give a comprehensive view of the impact of the entire processing method (from raw material to product) on the material.

Intensification of the mass transfer during VI will result in the possibility of impregnation of difficult-to-impregnate raw materials or the optimization of impregnation of material characterized by substantial porosity. Such optimization may consist in reducing the vacuum depth, shortening the process time, reducing the concentration of the solution, etc. These changes will obviously affect the economy of the process. During the literature query, it was stated that there is a lot of papers on the impregnation (under vacuum or atmospheric pressure) of the fruit and vegetables pre-treated with ultrasound. However, only one work was found regarding the ultrasound-assisted VI, at which the acoustic waves were applied both during vacuum and at atmospheric pressure. According to the authors, the application of ultrasound during VI did not rupture cellular integrity, but it led to increases in the content of analyzed compounds, minerals and inhibited the growth of the pathogenic microorganisms over the storage. Thus, additional experimental works need to be done to explain how raw materials with various structure will behave during ultrasound-assisted processes. It should be noted that the mechanisms of ultrasound action are not fully understood and unexpected phenomena are still observed.

Understanding the impact of ultrasound on the mass transfer during impregnation of plant materials and its properties may contribute to deepening knowledge about the influence of acoustic waves on the other operations, especially those carried out in the liquid phase (e.g. extraction, emulsification, agglomeration, mixing etc). Due to the lack of research on the ultrasound-assisted VI, the results of this project will be a valuable contribution to the widening of knowledge about ultrasound and processes supported by ultrasound, and will also fill a gap existing in the present state of knowledge.